Claims

[c1] 1.A method for diagnosing operation of an electric motor, comprising:

determining a first shaft position using a sensorless control system;

determining a second shaft position using a position sensor; and

evaluating operation of said electric motor based at least in part on comparison of said first shaft position to said second shaft position.

[c2] 2.The method according to claim 1, further comprising evaluating operation of said sensorless control scheme based on said second shaft position.

[c3] 3.The method according to claim 1, further comprising evaluating operation of said position sensor based on said first shaft position.

[c4] 4.The method according to claim 1, further comprising determining a modified shaft position based on said first shaft position and said second shaft position.

[c5] 5.The method according to claim 4, further comprising:

transmitting said modified shaft position to a torque controller; and

transmitting a voltage command from said torque controller to an inverter.

[c6] 6.A method for controlling an electric motor, comprising:

determining an electric motor rotational speed;

operating said electric motor using a sensorless control system if said electric motor rotational speed is above a predetermined threshold; and

operating said electric motor using a sensor based control system if said electric motor rotational speed is below said predetermined threshold.

[c7] 7.The method according to claim 6, further comprising correcting said sensorless control system with said sensor based control system.

[c8] 8.The method according to claim 6, further comprising correcting said sensor based control system with said sensorless control system.

[c9] 9.The method of claim 6, wherein the step of operating said electric motor using a sensorless control system if said electric motor rotational speed is

above a predetermined threshold comprises the steps of:

determining motor speed and position from a plurality of phase current and phase voltage signals;

determining an inverter voltage command from said motor speed and position; and

determining the plurality of phase current and phase voltage signals from said inverter voltage command.

[c10] 10.The method of claim 9, further comprising:

determining motor speed and position from a position sensor; and

correcting said phase current and phase voltage signal determined motor speed and position with said position sensor determined motor speed and position.

[c11] 11.The method of claim 6, wherein the step of operating said electric motor using a sensor based control system if said electric motor rotational speed is below said predetermined threshold step comprises the steps of:

determining motor speed and position from a position sensor;

determining an inverter voltage command from said motor speed and position; and

determining a plurality of phase current and phase voltage signals from said inverter voltage command.

[c12] 12.The method of claim 11, further comprising:

determining motor speed and position from a plurality of phase current and phase voltage signals; and

correcting said position sensor determined motor speed and position with said phase current and phase voltage signal determined motor speed and position.

[c13] 13.The method of claim 6, wherein said predetermined threshold is about 50 rpm.

[c14] 14.The method of claim 6, wherein said predetermined threshold is in the range of about 10 rpm to about 100 rpm.

[c15] 15.A system to control an electric motor comprising:

an inverter operatively connected to said electric motor;

a position estimator operatively connected to said electric motor and said inverter;

a torque controller operatively connected to said position estimator and said inverter;

a position sensor operatively connected to said electric motor and said position estimator;

a processor for determining a first electric motor shaft position based on an output from said inverter;

said processor ordered to determine a second electric motor shaft position based on an output from said position sensor; and

said processor programmed to correct said first electric motor shaft position by using data related to said second electric motor shaft position.

[c16] 16.The system according to claim 15 wherein said processor is programmed to correct said second electric motor shaft position using data related to said first electric motor shaft position.

[c17] 17.The system according to claim 15, wherein said position sensor is a low resolution position sensor.

[c18] 18.The system according to claim 15, wherein said position sensor is an engine crankshaft position sensor.

[c19] 19.The system according to claim 15, wherein said position sensor is an engine camshaft position sensor.

[c20] 20.The system according to claim 15, wherein said position sensor is a transmission sensor.

[c21] 21.An vehicle comprising:

an electric motor;

an inverter operatively connected to said motor;

a position estimator operatively connected to said motor and said

inverter;

a torque controller operatively connected to said position estimator and said inverter;

a position sensor operatively connected to said motor and said position estimator;

means for determining a first electric motor shaft position based on an output from said inverter;

means for determining a second electric motor shaft position based on an output from said position sensor; and

means for correcting said first electric motor shaft position by said second electric motor shaft position output.

[c22] 22.The vehicle according to claim 21, further comprising means for correcting said second electric motor shaft position by said first electric motor shaft position output.

[c23] 23.The vehicle according to claim 21, wherein said position sensor is a low resolution position sensor.

[c24] 24.The vehicle according to claim 21, wherein said position sensor is an engine crankshaft position sensor.

[c25] 25.The vehicle according to claim 21, wherein said position sensor is an engine camshaft position sensor.

[c26] 26.The vehicle according to claim 21, wherein said position sensor is a transmission sensor.

[c27] 27.An article of manufacture for controlling an electric motor, comprising:

a computer readable storage device; and

a control strategy embodied in said computer readable storage device for directing a computer to control the steps of determining an electric motor rotational speed, operating said electric motor using a sensorless control system if said electric motor rotational speed is above a predetermined threshold, and operating said electric motor using a sensor based control system if said electric motor rotational speed is below said predetermined

threshold.

[c28] 28.The article of manufacture according to claim 27, wherein said predetermined threshold is about 50 rpm.

[c29] 29.The article of manufacture according to claim 27, wherein said predetermined threshold is in the range of about 10 rpm to about 100 rpm.